

975,911. Pulse generators. UNITED KINGDOM ATOMIC ENERGY  
AUTHORITY. May 14, 1962 (May 18, 1961). No 18136/61 Heading H3P.

A high-voltage pulse-generator comprises two sheets 1, 2 of conductive material and two sheets of insulant (not shown) arranged alternately and wound together in a roll to form a structure which may alternatively be regarded as a roll capacitor or as two open ended strip transmission lines having a common conductor. The path of propagation through one of these lines is indicated by a broken line (this is the "active" line) and the path through the other (the "passive" line) is not marked. The sheets may be charged from a source (not shown) and a discharge may be initiated by closing a switch which is connected across one of the transmission lines formed by the sheets at points AO about midway along it. It is stated that a voltage having a value about one hundred times the charging voltage is built up between the extremities of the sheets and that a triangular pulse having a peak amplitude may be derived between terminals at the inner and outer ends of one of the sheets. The described mode of operation of the generator is not amendable to detailed abridgement but may be deduced by considering the effects of the travelling waves which originate at OA when the switch is closed and propagate in the directions shown towards the open end of the "active" transmission line. Only half of the capacitor is discharged during the time the wave takes to travel to the extremities of the line. At these points it is reflected and recharges the line but at a potential opposite in sign to the original potential across the line. On arrival of the waves at the switch a total voltage of  $2_n V$  ( $n$  is the number of turns,  $V$  is the charge voltage) exists between the extremities of the sheets and upon the second arrival of the waves at the switch this voltage again becomes zero. The cyclic process is theoretically endless, but this practice is limited, amongst other things, by (a) resistive losses due to small skin-depth and small characteristic impedance; (b) coupling between the ends of the lines. Improved performance can be obtained by tapering the ends of the lines by inserting a ferromagnetic core to increase the inductance or by separating the ends of the sheets by 180 degrees. Switch inductance is reduced by using high-pressure gas, liquid or solid dielectric switches. The conductors may be made of aluminum foil and the insulators from polyethylene tetrathalate. The whole binding is potted in an epoxy resin.

988,777. Pulse generators. UNITED KINGDOM ATOMIC ENERGY  
AUTHORITY. Jan. 4, 1963 (Jan. 9, 1962) No. 799/62, Heading H3P  
(Also in Division H1)

A pulse generator of the kind described in Specification 988,778, has a make switch for establishing a conducting path between a pair of electrodes, the switch comprising solid dielectric material separating the electrodes, the material being

**Bypass control for testing, Fig. 7.**—Alternate paths from terminal 60 signal "1" or "0" under the control of arrays 58, 59 representing a function ( $f$ ) and negation of the function ( $\bar{f}$ ). In normal use of the system, no currents are applied to terminals 67 to 70, but for testing, currents on terminals 67, 68 disable the outputs from functional arrays 58, 59 and a current on terminal 69 or 70 selects the output desired. The last stage of a system can be tested by controlling the penultimate stage to feed selected signals to the last stage. When the last stage has been tested and found correct, the penultimate stage is tested by feeding selected signals thereto.

**Disa control for testing, Fig. 8.**—In normal operation, cryotron 74 is operated to de-couple the two output leads 65<sup>1</sup>, 66<sup>1</sup>, the output being determined by functional arrays 58<sup>1</sup>, 59<sup>1</sup>. For testing, the cryotron 74 is allowed to lapse into its superconducting state to couple leads 65<sup>1</sup>, 66<sup>1</sup> and one of the cryotrons 75, 76 is operated to select the desired output.

**Redundant circuits, Fig. 1.**—Identical arrays A, A<sup>1</sup>, A<sup>2</sup>, representing functions  $f_1$ ,  $f_1^1$ ,  $f_1^2$  are controlled by identical sets of input signals  $a_1$  to  $a_n$ ,  $a_1^1$  to  $a_n^1$ ,  $a_1^2$  to  $a_n^2$  to feed binary outputs on line pairs to majority circuits M, M<sup>1</sup>, M<sup>2</sup>. Outputs  $f_2$ ,  $f_2^1$ ,  $f_2^2$  are mutually identical but an error in one output is eliminated in a further majority circuit (see later).

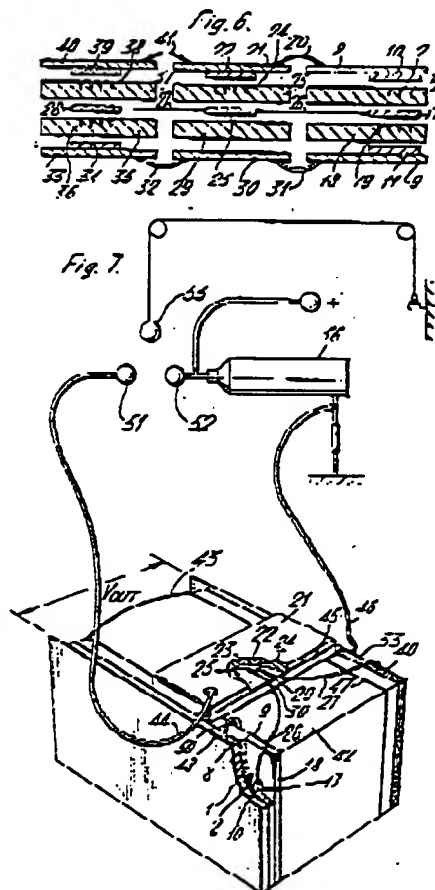
**Majority circuit, Fig. 12.**—A "1" signal on all three or on any two of terminals 81, 82, 83 gives a "1" output on terminal 85.

**Date handling system, Figs. 13, 14.**—Majority circuits 175 are fed through three channels including logical arrays 161, 163, 165 controlled by signals  $a$ ,  $b$ ,  $a^1$ ,  $b^1$  and  $a^2$ ,  $b^2$ . Bypass circuits 163, 165, 167 facilitate testing. Three majority circuit output pairs 176, 177, 178, 179 and 180, 181 feed logic arrays 183, 185, 187 which use further identical inputs  $c$ ,  $c^1$ ,  $c^2$  to derive further functions  $f_2$ ,  $f_2^1$ ,  $f_2^2$  and  $f_3$ ,  $f_3^1$ ,  $f_3^2$  which are fed to majority circuits 213, 214. As shown, bias control circuits are included in the outputs of logic arrays circuits 183, 185, 187 for testing purposes.

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A pulse generator of the kind described in Specification 988,778, has a make switch for establishing a conducting path between a pair of electrodes, the switch comprising solid dielectric material separating the electrodes, the material being provided with at least one channel extending in a direction from one electrode to the other and terminating at a predetermined point within the material, the shape of the channel at the point being adapted to increase electrical stress thereat when elec-

trical stress is applied to the material and to produce electrical breakdown of the material. As shown, Fig. 6, two three-electrode switches are connected to a central trigger switch formed



between copper sheets 21 and 30. Pulse-charging connections 44, 46, Fig. 7, are taken from sheet 21 and sheet 33 respectively to a capacitor 56 which is charged by a Cockcroft-Walton generator (not shown). In operation of the generator of Fig. 7, a charging waveform is applied via connections 44 and 46 until the gap between discs 25 and 22 in the trigger switch becomes over-volted and breaks down. Copper sheet 45 acts as a capacity divider to maintain the volts on disc 25 at the required fraction of the charging voltage. Upon breakdown, the voltage change on disc 25 is transmitted to discs 17 and 28, which act to short-circuit substantially simultaneously the non-output ends of sheets 18 and 9, and 40 and 33 respectively, and to generate an output pulse between the output ends of sheets 33 and 48.